Soils Investigation of Riparian Communities of East Smiths Fork and Henrys Fork Drainages North Slope Uinta Mountains, Utah.

Final Report

Principal Investigator: Sherman E. Jensen

Report Compiled by Sherman Jensen and Joel S. Tuhy

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CHAPTER I
OBJECTIVES

The principal objective of this study is to develop soil-vegetation-environment relations for riparian communities of East Fork Smiths Fork (SF) and Henrys Fork (HF) drainages, of the North Slope Uinta Mountains.

Specific activities in response to the principal objective are:

1. To describe a soil pedon for each of 41 plots.
2. To describe some hydrologic and physical parameters of plots.
3. To classify soil pedons to the family level.
4. To interpret soil pedons for characteristics which may reflect communit condition or affect the rate and/or direction of ecosystem processes.
5. To develop concepts derived from descriptions, classifications and interpretations for floristic communities.

Floristic and wildlife parameters of these plots have been previously described by Forest Service Personnel (report in progress).

Detailed floristic descriptions of HF were not conducted. Floristics of some of these plots were described by the principal investigator in sufficient detail for a tentative community type (ct) classification; others were not. Plots not described by these authors or Forest Service personnel are noted in APPENDIX C, but are not considered in subsequent analysis and concept development.

Due to inherent complexity of spatial arrangments in riparian communities, some ambiguities may exist between locations of Forest Service plots and those described by this study. A thorough comparison of floristic descriptions prepared by these authors and floristic parameters measured by Forest Service personnel (using Site Analysis Forms) should be conducted before any future soil-vegetation correlations.

Physical Descriptions

Some environmental parameters thought to affect the rate and/or direction of ecosystem processes were described. Environmental parameters described include:

1. A cross-sectional sketch of the valley bottom including position of plot, sources and direction of subsurface flow, and schematics of adjacent communities.

2. An estimate of the percent slope for communities with slopes greater than 5%.

3. A description of the surface microtopography of the community.

4. Descriptions of types and relative severity of disturbance.

5. Estimates of distance between community and the active stream waterlevel.

6. The depth and type of surface litter.

7. An estimate of percent bare ground (100% - basal crown% - coverage by litter% = % bare ground).

An exemplary Physical Description Form is presented in APPENDIX A. The general appearance and physiography of the community and the nature of surrounding communities were also described on the Physical Description Form.

Soil Descriptions

A soil profile was described for each sample plot to a depth of one meter, or to some depth below the ground water level (gwl) if shallower than one meter, or to a depth where gravel and cobbles in a heavy clay matrix made continued excavation impracticable. Methods of profile description conform to those described in Soil Taxonomy (USDA-SCS,1975). Definitions and abbreviations used in profile descriptions are adopted from "Definitions and Abbreviations for Soil Descriptions" (USDA-SCS,1979b).

The depth to ground water (gwl) was measured for each profile or estimated from moisture status and morphologic characteristics at the lowest depth described. Due to the lateness of season, gwls were below normal. Stream water levels were 10 to 20 cm below the normal flow level. Heavy clay horizons gleyed by prolonged reducing conditions, and coarse-textured horizons with common mottles indicative of intervals of saturated conditions were noted above gwls in dry to moist states. For each pedon, morphological characteristics were used to ascertain the normal seasonal gwl.

Soil moisture is maintained at field capacity (the maximum quantity of water a freely drained soil will hold) at some depth above the gwl. Soils at field capacity are near-saturated, except in non-capillary pores. The depth to near-saturated conditions of the depth to the capillary fringe was noted for each profile. The normal depth to capillary fringe was inferred from morphologic characteristics including textural class, degree of mottling and degree of organic matter (OM) decomposition of horizons above the normal gwl. An exemplary soil description form is presented in APPENDIX A.

Office Procedures

Soil Interpretations

Each pedon description was interpreted to determine water handling and erosion characteristics. Specific interpretations conducted are:

1. Drainage Class
2. Permeability to the gwl.
3. Hydrologic soil group.
4. Mean available water holding capacity of horizons above the normal gwl.
5. Current erosion estimate.
6. Inherent erodibility of the surface horizon.

Interpretations are described and classes defined in CHAPTER III - RESULTS.

Soil Taxonomy

Taxonomic classification of soil pedons is based on morphology as described for soil profiles. Taxonomic criteria conform to those stated in Soil Taxonomy (USDA-SCS, 1975b). Each pedon was classified to the family level.

Taxonomic classifications sometimes do not rigorously conform to criteria of the taxonomic unit (taxon) but are best typified by its concept. In Aquic Suborders and Subgroups the criteria of reduced mottles is notably lacking. These soils are saturated to the surface or within some subsurface horizon for part or all of the growing season, yet reduced mottles were not always observed. Surface waters moving through riparian systems may contain dissolved oxygen in sufficient concentrations to oxidize Fe and Mg precipitates.

Taxonomic concepts and distinguishing criteria of taxa are identified in CHAPTER III - RESULTS.

Soil-Plant Relations

Plots were organized in overstory groups (ogs) and understory groups (ugs) based on floristic descriptions of this study (Smiths Fork plots) and on descriptions conducted by Forest Service personnel (Henrys Fork plots). A "group" is a collection of communities with similar overstories or similar understories. Single overstory groups may have several different understories. A community type (ct) is a combination of a distinct overstory group (og) and understory group (ug).

Pedogenic and physical parameters of ogs and ugs were examined for characteristics of similarity. Analysis of Variance (AOV) was conducted for fac-

tors of each ug and of the same factors present in its associated ogs. Fisher's Protected Least Significant Difference (LSD) was utilized for multiple comparison of significant factors. Mean values and standard deviations were calculated for ugs and cts. Statistical measures and tests may not accurately describe or delineate characteristics of all ugs and cts due to the limited number of samples and the inclusion of atypical and transitional plots. Data from SF and HF should be integrated with more extensive data files as the data base is expanded.

Concepts developed for groups and community types are founded on descriptions and interpretations and are influenced by the authors' experience in riparian research in other montane areas.

CHAPTER III - RESULTS

Floristic Classifications

Understory Groups

Six ugs are defined for SF and HF drainages. Understory groups (ugs) are named for dominant or indicator species or for the descriptive class of the herbaceous faction. Understory groups and acronyms are presented in Table 1.

Table 1. Understory groups (ugs) and acronyms.

Understory Group	Acronym
Eleocharis pauciflora	ELPA
Swertia perennis	SWPE
Carex rostrata	CARO
Calamagrostis canadensis	CACA
Mesic herbs	MESIC
Deschampsia cespitosa	DECE

Overstory Groups (ogs)

Three dominant ogs were identified within the study area, as well as a fourth group that has no overstory (herbaceous group). Dominant overstory groups are listed in Table 2.

Table 2. Overstory groups (ogs) and acronyms.

Overstory Group	Acronym
Salix geyeriana	SAGE
Salix wolfii	SAWO
Salix phylicifolia	SAPH
Herbaceous	HERB

Overstory groups are often not distinct, i.e., a combination of dominant *Salix* overstory species often occur together in a single community: *S. geyeriana* generally occurs with *S. wolfii* and/or *S. phylicifolia* as a substory, and *S. wolfii* and *S. phylicifolia* often occur together. Plots with *S. geyeriana* dominating the overstory were grouped into the SAGE og, irrespective of substory composition.

Communities codominated by *S. wolfii* and *S. phylicifolia* were tentatively classified to the og of the most dominant species. As research continues, it might be ascertained that pedogenic and physical parameters of these groups are similar enough to combine ogs into simpler units. The philosophy of the author is to examine the finite first and classify based on this examination.

Two very minor ogs were also noted by these or other scientists:

1. A very small community with an overstory dominated by *Vaccinium occidentale*;

2. Patchy occurrences of *Salix exigua*-dominated areas in the lower portions of SF drainage (Dave Winn, pers. comm.).

Very minor ogs were not described.

Tentative Community Types (cts)

A community type (ct) is the combination of an og and an ug and is the fundamental unit of the classification system. Tentative cts, acronyms and the number of communities described are listed in Table 3. Community types presented in Table 3 are tentative and may be modified based on the results of more extensive investigation.

Table 3. Acronyms and number of plots described for tentative community types (cts).

Tentative Community Types	Acronyms	n
Carex rostrata - *C. aquatilis*	CARO	6
Salix geyeriana/CARO	SAGE/CARO	4
Salix wolfii/CARO	SAWO/CARO	6
Salix phylicifolia/CARO	SAPH/CARO	2
S. wolfii/*Swertia perennis*	SAWO/SWPE	5
Eleocharis pauciflora	ELPA	5
S. geyeriana/*Calamagrostis canadensis*	SAGE/CACA	3
S. Phylicifolia/CACA	SAPH/CACA	7
S. geyeriana/Mesic herbs	SAGE/MESIC	1
S. wolfii/Mesic herbs	SAWO/MESIC	3
S. phylicifolia/Mesic herbs	SAPH/MESIC	2
Deschampsia cespitosa	DECE	3
S. phylicifolia/DECE	SAPH/DECE	1

CHAPTER II
METHODS

Field

General

A field investigation was conducted to describe soil, hydrologic and physical parameters for each of 41 established plots. Locations of plots were determined from pinholes in aerial photographs. The method of locating plots was not without problems. In some instances, plots were marked at the intersection between distinct floristic communities or within transitional zones. Brief floristic descriptions supplied by the Forest Service were often not of sufficient detail to determine correct plot locations. Detailed floristic data (Site Analysis Forms) collected by the Forest Service was not available. Where ambiguities in plot locations were encountered, parameters were described for the dominant or typic plant community of the area.

The field investigation was instigated in early October, 1981 and consisted of two sessions. During the initial session, soil descriptions for plots of HF and upper SF were prepared. Soil descriptions for lower SF and brief floristic descriptions for all SF plots were conducted the second session. These floristic descriptions should be compared with Forest Service Site Analysis forms before conducting further correlation procedures. Weather conditions precluded the gathering of floristic descriptions for HF.

Six additional plots were established in SF. These plots were established to increase the data base for communities previously described and to include descriptions of minor communities not previously treated. Plot locations are marked on attatched topographic maps and are also pinpricked on aerial photos.

Floristic Descriptions

Brief floristic descriptions were conducted for 37 plots of SF drainage. Descriptions were conducted to enable verification of correct plot location and to facilitate tentative classification of plant communities.

Floristic descriptions consist of lists of all identifiable species for the community of concern. Neither cover not dry weight estimates were conducted although dominant and indicator species were noted. An exemplary floristic description is presented in APPENDIX A. The general appearance and physiognomy of communities was described on a Physical Description form, also presented in APPENDIX A.

These plots were identified as tentative community types (cts). Tentative classifications are subjective in nature but are based on objective expertise garnered in other riparian classification studies (Norton et al.,1981; Tuhy, J.S. and S.E. Jensen, in progress). Generally, tentative community types are variants of cts defined for tributaries of the Greys River, Wyoming and the Salmon River and its tributaries in central Idaho.

Soils

Soils of SF and HF plots were classified as Entisols, Mollisols, Histosols and Inceptisols at the Order level. Brief descriptions of taxa to the Subgroup level are presented in Table 4. Following is a discussion of taxa to the Subgroup level, with respect to each soil Order.

Entisols

These are young soils with little or no in situ development. The absence of pedogenic horizons may be a result of insufficient time, an anaerobic environment which restricts chemically and biologically triggered oxidation reactions, or active erosion and deposition proceeding at a rate equal to or greater than that of pedogenic processes.

At the Suborder level, Entisols were classified as Aquents and Fluvents. Aquents are saturated at and below the soil surface for most of the growing season. Fluvents are soils with characteristics other than those of Aquents, and in which the organic carbon content decreases irregularly with depth. They include those soils with distinctly segregated horizons indicative of fluvial deposition.

At the Great Group level, Entisols are classified as Cryaquents and Cryofluvents. The mean annual soil temperature at 50 cm below the surface is greater than $0^{o}C$, but less than $8^{o}C$; mean summer temperatures are less than $15^{o}C$, as defined for the cryic temperature regime.

All Cryaquents are Typic at the Subgroup level. The Subgroup exhibits a wide range of wet and cold soil properties. Some Typic Cryaquents have an organic horizon at the surface or buried beneath a layer of mineral material. An aerobic environment and cool temperatures limit the rate of OM decomposition. Organic horizons are composed primarily of relatively undecomposed (fibric) soil material.

Three subgroups of Cryofluvents were distinguished: Typic, Aquic and Mollic. Typic Cryofluvents are not saturated above 50 cm from the suface for significant periods of the growing season, and do not have surface horizons appreciably darkened by mineralized OM to the extent defined for a Mollic epipedon.

Aquic Cryofluvents deviate from the Typic concept in that they are saturated within 50 cm of the surface for significant periods of most growing seasons. This is evidenced by mottles of low chroma in surface horizons which may be darkened by OM to the extent defined for Mollic epipedons, but which are not thick enough to be classified as Mollisols. Aquic Cryofluvents are intergrades to Aquents.

Mollic Cryofluvents are not saturated within 50 cm of the surface for significant periods. They have a surface horizon appreciably darkened by OM, but this horizon is not thick enough to be definitive of a Mollic epipedon. Mollic Cryofluvents are intergrades to Mollisols.

Table 4. Distinguishing soil taxonomic criteria to the subgroup level.

Classification	Taxonomic Criteria
Order	Order
Suborder	Suborder
Great Group	Great Group
Subgroup	Subgroup
Entisols	No pedogenic horizons
Aquents	Saturated to surface
Cryaquents	Cool temperature regime
Typic	None
Fluvents	Deposited by periodic flooding
Cryofluvents	Cool temperature regime
Typic	None
Mollic	Epipedon of OM accumulation
Aquic	Saturated within 50 cm
Orthents	Other Entisols
Cryorthents	Cool temperature regime
Aquic	Saturated within 50 cm
Mollisols	Mollic epipedon (ep)(OM accumulation)
Aquolls	Saturated to surface at some time
Cryaquolls	Cool Temperature regime
Typic	gwls above 1 m (>90 days)
Histic	Histic ep over Mollic ep
Borolls	Cool temperature regime
Cryoborolls	Cool temperature regime
Aquic	gwls above 1m (>90 days)
Cumulic	ep > 50 cm thick

Table 4. (continued)

Classification	Taxonomic Criteria
Order Suborder Great Group Subgroup	Order Suborder Great Group Subgroup
Histosols Fibrists Borofibrists Terric	Organic soils Least mineralized OM Cool temperature regime Mineral horizon present
Hemists Borohemists Terric	Moderately mineralized OM Cool temperature regime Mineral horizon present
Saprists Borosaprists Terric	Most mineralized OM Cool temperature regime Mineral horizon present
Inceptisols Ochrept Cryochrept Aquic	Altered horizons Ochric epipedon Cool temperature regime gwl above 75 cm

Mollisols

These soils are characterized by a surface horizon appreciably darkened by mineralized OM, to the extent defined for Mollic epipedons. No subsurface diagnostic horizons were observed. Subsequent classifications of Mollisols are distinguished on the basis of soil moisture regime, thickness of the Mollic epipedon and presence or absence of Histic epipedon.

At the Suborder level, Mollisols saturated to the surface for significant periods of the growing season are classified as Aquolls. Characteristics associated with wetness include distinct mottles at or near the base of the epipedon, matrix colors below the epipedon of low chroma (indicative of a prolonged reducing environment) and groundwater present at such a shallow depth that the capillary fringe (cf) reaches the soil surface (except in non-capillary pores). Since the genesis of Mollic epipedons requires aerobic conditions favorable to OM mineralization, the period of time the soil is saturated may be somewhat less than that of Aquents. The author's concept of Aquolls is characterized by a fluctuating gwl, although the taxonomy is not explicit on this point.

Mollisols not saturated to the surface for significant periods are classified as Borolls at the Suborder level. These Mollisols are characterized by a cold (cryic) temperature regime.

At the Great Group level, Mollisols are classified as Cryaquolls and Cryoborolls. Soil temperatures are definitive of a cryic temperature regime.

Two Subgroups of Cryaquolls were designated: Histic and Typic. Those Cryaquolls with a Mollic epipedon less than 40 cm thick and having no organic surface horizon definitive of a histic epipedon are Typic Cryaquolls. Histic Cryaquolls have a histic epipedon and are saturated for most of the growing season.

Cryoborolls are classified as Cumulic or Aquic at the Subgroup level. The Cumulic Subgroup has a Mollic epipedon greater than 50 cm thick and may be saturated within one meter of the surface for greater than 90 consecutive days. Although no Typic Cryoborolls were described, they probably occur near the transitions from riparian to upland in broad valley systems. Typic Cryoborolls are not saturated within one meter of the soil surface for as long as 90 consecutive days.

Aquic Cryoborolls are saturated in some horizon above one meter for greater than 90 consecutive days and do not have an overthickened epipedon. These soils are characterized by bright, prominent mottles within one meter of the surface. Most Cryoborolls of riparian zones of HF and SF drainages are of the Aquic Subgroup.

Histosols

Generally, Histosols are soils in which at least 50 percent of the surface 80 cm is greater than 50 percent OM. The cumulative thickness criteria may be modified when organic material rests on rock or fragmental material. Subsequent taxa are determined to the Subgroup level by the degree of OM decomposition, soil temperature regime and presence of mineral horizons. At the Suborder level, soils are Fibrists, Hemists and Saprists.

Fibrists are organic soils in which the botanic origin of the dominant OM is recognizable. These are the least decomposed organic soils identified, and are generally permanently saturated in fibric horizons.

The dominant OM is intermediately decomposed in Hemists. Organic matter (OM) is of high fiber content, but is generally not recognizable as to botanic origin. Hemic horizons are generally saturated most of the time when temperatures are greater than biologic zero.

Saprists are organic soils in which the dominant OM is almost completely decomposed. The fiber content of OM is low and not recognizable as to botanic origin. A fluctuating soil moisture regime or flowing ground water containing sufficient dissolved oxygen for biologic processes characterize sapric horizons.

At the Great Group level, Histosols were identified as Borofibrists, Borohemists and Borosaprists on the basis of soil temperature regime. At the Subgroup level, Histosols are Terric, indicating a mineral horizon within 130 cm of the surface.

Inceptisols

A single taxon of Inceptisols was described: an Aquic Cryochrept. This taxon has an epipedon with relatively low OM content (Ochric epipedon), a subsurface horizon altered by pedogenic processes (cambic horizon), a cool temperature regime and is continuously saturated in some subsurface horizon above 75 cm. These soils generally occur in areas adjacent to upland communities.

Family Differentiae of Mineral Soils

Differentiae at the family level for mineral soils are: Particle-size class; mineralogy class; and soil temperature class.

Particle-size classes range from fragmental to fine. Soils are of mixed mineralogy class.

All soils occurring on the sites are of frigid soil temperature classes. Since the frigid family modifier is implied in all Boric Suborders and Cryic Great Groups, repetition as a family modifier is redundant and has been omitted.

Family Differentiae of Organic Soils

The particle-size classes of Terric Subgroups of Histosols range from sandy to fine. The mineralogy class is mixed as for mineral soils. Organic horizons all have a pH above 4.5, as definitive of the euic reaction class. Soil temperature classes are stated at the Great Group level.

Soil Interpretations

Soil interpretations may serve a better purpose if used to further characterize soil families and provide criteria for broad scale, general management decisions than in outlining site-specific decisions. Criteria for interpretation of classes are presented and referenced in APPENDIX B. Each interpretation is now discussed.

Drainage Class. Classes are based on morphological characteristics which reflect the degree of aeration within the soil profile: Depth to gwl; textural class; stucture; and evidence of oxidation-reduction processes. Classes observed range from very poorly drained to moderately well drained.

Profile Permeability. Permeability is a relative measure of the transmittance of water through the soil profile under saturated conditions. Permeability is a function of soil texture, structure, coarse fragment composition and presence or absence of horizons restrictive to downward water movement. Permeability was determined for the horizon most restrictive to downward water flow above the normal gwl. Permeability classes ranged from very slow to rapid.

Available Water-Holding Capacity (AWC). Available water-holding capacity (AWC) is a measure of water that a freely drained soil may retain between 1/3 and 15 bar tensions, and is a function of textural class, coarse fragment composition and presence or absence of organic horizons. AWC of organic material is many times greater than AWC of mineral material. A conservative estimate of AWC for organic horizons (30% by volume) was utilized in calculations. Estimates of average AWC were calulated for horizons above the normal gwl. The presence of surface and subsurface organic horizons in Aquic Suborders and Subgroups greatly increases AWC.

Hydrologic Soil Groups (Runoff Potential). Hydrologic soil groups (HSGs) are used in watershed planning to estimate runoff from snowmelt and precipitation. Groups are determined by those factors influencing infiltration and permeability, in addition to the depth to the gwl. Each HSG is definitive of a runoff potential class. The influence of vegetation, slope and physiography are not considered in HSGs.

Inherent Erodibility. These classes are a measure of the potential soil loss by water erosion. Soil properties which influence erodibility by water are those that affect infiltration and permeability, and those which resist the dispersion and transport forces of rainfall and runoff. The presence of organic surface horizons in Aquic Suborders and Subgroups and in Histosols greatly reduces the potential soil loss. High OM contents in mineral horizons also reduce inherent erodibility.

Current Erosion. Erosion classes are based on estimated percent removal of surface "A" horizons. Shallow channels are the dominant type of erosion noted.

Typic Interpretations for Tentative cts. A range of interpretative clases applies to most cts; interpretations for specific plots may be referenced from APPENDIX C. Interpretations for typic communities are stated with respect to Descriptions of Classification Units.

Soil-Vegetation Analysis

Analysis of variance (AOV) was conducted to determine if mean values for selected soil and hydrologic characteristics of understory groups (ugs) are significantly different. This analysis was conducted irrespective of overstory groups (ogs). AOV was also applied to mean values of the same characteristics for ogs within given ugs; no significant differences wer e determined. Factors of ugs were significantly different. Mean values for ugs and cts, and results of multiple comparison analysis are presented in Table 6.

The relults of the AOV must be interpreted with reservation. The number of replicate samples are not sufficient to validate the hypothesis of no significant differences between characteristics of ogs within a given ug. Also, many plots are located in communities transitional between cts. Mean determinations may be somewhat distorted by the integration of these measurements. Data should be integrated with larger systems as the data base is expanded.

Table 5. Mean values for some parameters of ugs and cts, and results of AOV for significant factors of ugs.

ug og	N	Depth to gwl (1) X̄ (cm)	S	Depth to cf (2) X̄ (cm)	S	AWC (3) X̄ (%)	S	Depth of "O" (4) X̄ (cm)	S
ELPA	2	12A	18	0a	0	30a	0	92a	11
SWPE	4	22a	15	0a	0	26a	4	39b	40
SAWO	2	35	7	0	0	22	-	16	2
SAPH	2	10	10	0	0	30	2	62	53
CARO	19	42ab	20	32b	24	15c	4	4c	4
HERB	6	53	20	19	22	20	6	21	37
SAWO	6	37	21	7	10	22	6	13	4
SAPH	3	41	22	0	0	27	4	38	17
SAGE	4	34	24	2	4	19	6	6	8
CACA	10	60b	20	32b	24	15c	4	4c	4
SAPH	7	53	20	29	18	16	3	4	4
SAGE	3	75	13	39	38	15	5	16	4
MESIC	5	80b	19	80bc	25	15c	3	4c	34
SAWO	3	77	24	56	13	17	6	3	5
SAPH	1	110	-	90	-	15	-	12	-
SAGE	1	60	-	47	-	11	-	0	-
DECE	4	81b	19	58bc	21	16bc	4	0c	0
HERB	3	71	3	49	12	16	6	0	0
SAPH	1	110	-	85	-	18	-	0	-

(*) Values followed by a same letter are not significantly different at the 95% confidence level.
(1) Depth to the ground water level;
(2) Depth to the capillary fringe;
(3) Mean available water holding capacity above the normal gwl;
(4) Depth of organic horizons;

Description of Classification Units

Overstory Groups (ogs)

No significant differences were determined for factors of ogs. Overstory groups seemed to respond to elevational gradients or factors related to elevation gradients. The SAGE og was most frequently noted in the lower elevational portions of the study area. Although *Salix wolfii* was distributed throughout the study area, it was most often dominant over *S. phylicifolia* in the lower portion of SF. *Salix phylicifolia* dominated the ogs of the upper portions of SF and HF.

Understory Groups (ugs)

Six types of herbaceous strata (understory groups) were recognized. Each is named for dominant or indicator species or for the descriptive class of the herbaceous faction.

Eleocharis pauciflora (ELPA). This is a minor ug in the upper basins of SF. The ELPA ug probably also occurs in the high basins of HF, although this was not verified by a qualified botanist. Two communities were described.

Floristics. *Eleocharis pauciflora* is usually dominant; though in some communities tufts of *Scirpus cespitosus* are more conspicuous. Additional species may include *Carex aquatilis*, *C. limosa* and/or *Pedicularis groenlandica*.

Overstory Groups. Overstory shrubs are rare, though stunted individuals of *Salix phylicifolia* are sometimes present.

Other Classifications. The ELPA ct is present at higher elevations of granitic mountains in central Idaho. There are minor differences in associated species, but overstory is absent. Similar communities are rare or absent in western Wyoming.

Soils. This ug generally occurs at the base of sideslopes which transmit subsurface water flow. Soils are wet to saturated to the surface for most or all of the growing season (one plot described had five centimeters of standing water in mid-October). Soil characteristics of plots are presented in APPENDIX C.

Both soils described are Histosols with organic horizons greater than 80 cm thick. The degree of OM decomposition ranges from relatively undecomposed (fibric) material to very decomposed (sapric) material. This may reflect the degree of ground water aeration, periodic fluctuations in gwl, or reduction

of subsurface flow from sideslopes.

These soils are very poorly drained; available water-holding capacities are very high and inherant erodibility is low.

Swertia perennis (SWPE). The SWPE ug occurs frequently, mainly in middle to upper portions of the study area. Six communities were described.

Floristics. Carex aquatilis and/or Carex rostrata are usually present and may be dominant. In addition, the following species are conspicuous: Swertia perennis, Pedicularis groenlandica, Thalictrum alpinum and, on some sites, Sphagnum spp.

Overstory Groups. The main species component of the overstory is Salix wolfii. The SAWO and SAPH ogs occur in conjunction with the SWPE ug. The SWPE ug was not observed without an associated overstory. Generally, Salix wolfii and S. phylicifolia occur together within a single community. The value of delineating two community types based on overstory is questionable.

Other Classifications. The SWPE understory occurs beneath Salix wolfii var. idahoensis in central Idaho, and beneath S. wolfii var. wolfii in western Wyoming. Both have been named the SAWO/SWPE ct. Only rarely is SWPE associated with S. phylicifolia in Idaho; this willow was not observed in the Greys River drainage.

Soils. The SWPE ug occurs on wet, seepy slopes. Land forms are slightly concave to convex and hummocky or undulating in a direction parallel to the slope.

Soils are characterized by an organic surface horizon and are saturated to the surface by laterally flowing ground water for most or all of the growing season. Taxa and some pertinent soil characteristics of plots are presented in APPENDIX C.

Most pedons described are Aquic Suborders or Subgroups of Entisols. One Histosol was described. A typical profile has a surface organic horizon 10 to 30 cm thick, subtended by a loamy horizon containing moderate amounts of mineralized OM. Particle-size classes of these soils are on the fine end of loam or finer.

SWPE soils generally have high AWC above the normal gwl, very poor to poor drainage and slow permeability rates through subsurface horizons. Inherent erodibility of surface horizons is generally low.

Carex rostrata-Carex aquatilis (CARO). This ug is extensive throughout the study area. Nineteen communities were described.

Floristics. Carex rostrata is usually dominant; Carex aquatilis is often present and may be codominant, but is rarely dominant. Swertia perennis and Pedicularis groenlandica are usually absent. Calamagrostis canadensis and/or Deschampsia cespitosa may be present in minor amounts.

Overstory Groups. SAPH, SAWO, SAGE and HERB ogs were described with respect to the CARO ug. Low willow ogs were generally a mixture of both Salix wolfii and S. phylicifolia. Communities of the SAGE og have low willows in the substory.

Although soil and hydrologic characteristics were not determined to be significantly different, some inferences merit discussion. The HERB og generally occurs in flat, concave locations not subjected to subsurface lateral flow. Salix-dominated ogs are common on gentle to moderately steep slopes with considerable subsurface lateral flow. The hypothesis is that Salix species are responding to the relatively higher level of aeration in flowing groundwaters.

Communities dominated by S. geyeriana are most prevalent in the lower portions of the study area. Communities with SAWO, SAPH and transitional ogs are most common in the middle and upper portions of the study area.

Other Classifications. The CARO herbaceous stratum occurs with and without Salix overstory in central Idaho and western Wyoming. It can be expected in similar marshy habitats throughout the circumboreal ranges of Carex rostrata and C. aquatilis.

Soil. Surface horizons of the CARO ug are wet for significant periods of the growing season. The ug occurs in areas ranging from flat, concave locations to moderately steep, convex slopes. Taxa and some pertinent characteristics are presented in APPENDIX C.

Most CARO ug soils are Aquic Suborders and Subgroups of Entisols and Mollisols. Two Terric Subgroups of Histosols were also described. Profiles are characterized by a surface organic horizon less than 20 cm thick over a mineral horizon with slight to moderately high mineralized OM accumulation. Particle-size classes are generally loamy. Communities without surface organic horizons are intergrades to drier ugs.

Available water holding capacities (AWC) above the normal gwl are moderate to high. Soils are somewhat poorly to very poorly drained and permeability is slow to moderate. Inherent erodibility is generally low due to organic surface horizons.

Calamagrostis canadensis (CACA). This ug commonly flanks stream channels in central valley bottoms. Ten communities were described.

Floristics. Calamagrostis canadensis generally dominates a variable herbaceous stratum with an appreciable forb complement. Carex rostrata, C. aquatilis and/or Deschampsia cespitosa may be present as subordinates.

Overstory Groups. The SAGE og and SAPH og occur over the CACA ug. SAPH ogs generally include some Salix wolfii. The SAGE og occurs predominantly in lower portions of the study area while the SAPH og occurs mainly in the middle and higher areas. Communities without overstory are rare and are never large.

Other Classifications. CACA occurs beneath several types of overstory in Idaho. Communities were observed with Salix geyeriana overstory, though perhaps not recurrent enough to merit a SAGE/CACA ct. Beneath S. drummondiana and/or S. myrtillifolia (neither common in Uinta Mountains) this forms the SADR/CACA ct. Beneath mature forest, this understory characterizes the Abies lasiocarpa/CACA habitat type.

In western Wyoming, CACA-dominated understories were occasionally observed beneath Salix drummondiana, S. boothii (=S. myrtillifolia), Cornus stolonifera and Picea spp., but they lack sufficient recurrence to be designated as community types.

Soils. Surface horizons of the CACA ug are moist for most of the growing season. Areas of occurence are generally even, and smooth to hummocky. Communities are often dissected with shallow channels which are active during high water stages. Taxa and some pertinent characteristics are presented in APPENDIX C.

Most CACA ug soils are Cryofluvents. Typic, Aquic and Mollic Subgroups were described. Profiles are characterized by a thin organic surface horizon or a thin mineral epipedon with high OM accumulation. Subsurface horizons are loamy and incorporate significant amounts of rounded cobbles and gravel. Most soils are of skeletal particle-size class.

Typically, these soils are somewhat poorly drained with moderate AWC. Permeability is moderate to moderately rapid and inherent erodibility of surface horizons is low to moderate.

Mesic Forbs (MESIC). The MESIC ug occurs in patches throughout the study area. Seven communities were described.

Floristics. The MESIC group is a "catch-all" for mixed forb/graminoid understories that are not dominated by Carex rostrata, C. aquatilis, Eleocharis pauciflora, Calamagrostis canadensis or Deschampsia cespitosa. These understories generally occupy non-marshy riparian habitats of interme-

diate wetness, hence the label MESIC. Forbs such as Aster occidentalis (plus Aster foliaceus), Fragaria virginiana and Achillea millefolium are often prevalent.

Overstory Groups. Communities described are associated with SAGE, SAPH and SAWO ogs. Although an herbaceous MESIC community was not described, some were noted in a tributary of SF. Significant differences were not observed between ogs, but sample sizes were small.

Other Classifications. Similar understories were observed in central Idaho and western Wyoming. Those sampled were included in more definitive, related units such as various Salix/Poa pratensis cts in Wyoming.

Soils. Surface horizons are moist for part, but generally not all of the growing season. Relative to riparian systems, these soils are moderate in hydrologic characteristics. Ground water levels (gwls) fluctuate between 50 and 100 cm below the surface. The ranges of some pertinent characteristics are presented in APPENDIX C.

Soils are Aquic Subgroups of Cryofluvents and Cryoborolls. Textural classes range from fine to fragmental. These soils have a thin organic surface horizon and a mineral epipedon appreciably darkened by mineralized OM as defined for Mollisols.

Soils have moderate AWC above the normal gwl. Profile permeability to gwl is rapid to slow, and soils are somewhat poorly to moderately well-drained. Inherent erodibility is moderate to low.

Deschampsia cespitosa (DECE). The DECE ug is the driest riparian group described. These communities form extensive meadows that are transitional to upland communities. Four communities were described.

Floristics. Deschampsia cespitosa dominates an herbaceous stratum which may contain a number of forbs. Carex rostrata and/or C. aquatilis may be present in minor amounts.

Overstory Groups. Most DECE communities are herbaceous, without an associated overstory. One community was described with an overstory dominated by Salix phylicifolia.

Other Classifications. A similar herbaceous DECE ug exists in central Idaho where it, again, seldom has overstory. Occasional DECE-dominated meadows were observed in western Wyoming, but were included within the broad Poa pratensis ct and may require reclassification.

Soils. These soils are dry in surface horizons for most of the growing season. They display a greater degree of pedogenic development than soils of other riparian ugs. Surfaces are generally smooth and even. Taxa and some pertinent characteristics are presented in APPENDIX C.

Soil Orders described are Mollisols, Inceptisols and Entisols. Epipedons are mineral and contain moderate quantities of mineralized OM,some to the extent definitive of mollic epipedons. One pedon incorporates a horizon of eluvial clay accumulation (argillic horizon) indicative of progressed in situ pedogenesis. This horizon occured in a solum less than 40 cm thick above a buried soil, and was not considered in the taxonomy. Textures are generally loamy above the gwl.

Available water holding capacities (AWC) above the normal gwl are moderate and soils are somewhat poorly drained with gwls at or below 70 cm. Permeability is slow to moderate and inherent erodibility is generally moderate.

CHAPTER IV
CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Soil and hydrologic parameters of plots in Henrys Fork and East Smiths Fork have been described. Soils have been interpreted and classified to the family level. Plant communities were described and classified to overstory and understory groups. The range of soil and hydrologic characteristics of understory groups have been described. Results are presented in CHAPTER III - RESULTS.

The authors have some reservation as to the achievement of the principal objective: to develop soil-vegetation-environment relations for riparian communities. Relationships for ugs were derived from a relatively small number of samples, and relationships were not apparent for overstory groups. Additional investigation will be necessary before soils-vegetation-environment relations can be determined at the ct level. Inferred relationships for ugs are stated in CHAPTER III - RESULTS.

Recommendations

The authors' contention is that too few communities have been described to determine soil-vegetation-environment relations for the area. It is suggested that data be integrated with more comprehensive data systems as they are developed.

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APPENDIX A

DESCRIPTION FORMS

Date: 9/12/81
Sample No: 8
Community: CARO

Taxonomic Classification: AQUIC CRYOFLUVENT, LOAMY OVER SANDY, MIXED

Horizon	Depth (cm)	Boundary	Color		Texture	Structure	Consistence			pH	Lime	Roots	Pores
			Dry	Moist	OM	Wetness	Dry	Moist	Wet				
A11	0-7	cs	—	7.5YR4/4 c2f 4/6	L-18c M	1fSBK mo	—	fr	ss ps	6.3	eo	fvf, cf	—
IIA12	7-25	gs	—	5Y4/1 f1d7.5YR4/6	SiL-16c M	1mSBK mo	—	fr	so ps	5.9	eo	fvf, ff	—
IIIA13	25-50	as	—	10YR3/2	L-16c M	1mSBK w	—	fr	ss po	6.1	eo	fvf, ff	fvf
IIIC1	50-80↓	—	—	2.5YR5/4	S	SG w-sat	—	lo	so po	6.4	eo	—	—

Remarks: H2O TBL. NORMALLY AT 50 CM; BACKWASH; OLD BEAVER POND (?);

Drainage: SOMEWHAT POOR

Permeability: MODERATE

Hydrologic Soil Group: C

Current Erosion: SLIGHT (MODERATE)

Inherent Erodibility: MODERATE

AWC: MODERATE
$(7(.17)+18(.18)+25(.17)) \div 50 = .17$

Depth to H_2O Table: 50 CM

Depth to Cap. Fringe: 25 CM

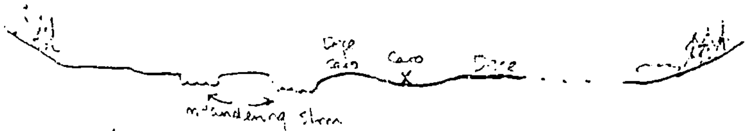
R7 #4 - SOIL
R7 #5 - PLANTS

Site 5 (

Date 8-27-81

ft/ m Slope ______ Aspect ______

VB width/shape: >? 30 m



Microtopography: COLUMNIF, HUMMOCKY (HUMMOCKS ARE 20-30 CM DIAM & 15-30 CM HIGH)

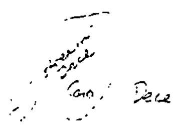
Disturbance type and severity:

- ______ low — [illegible] of [illegible] (corresponding [illegible] not [illegible] to Caro clumps) [illegible]:
- ✓ medium — [illegible] cattle tramping, & some frost action also?)
- ? high — (FROST HEAVING?)

General appearance/physiognomy: [illegible] dominated by Caro [illegible], Caro along with other characteristic wet herbs. CARO CT

Position in bottom:

-distance from stream 5 [illegible] to ca 15 m back, not adjacent



-height above stream level 50 CM

Surrounding communities, nature of boundaries:
d=distinct (0-1 m); c=clear (1-5 m); g=gradual (5-10 m); df=diffuse (>10 m).

[illegible] with more mesic species [illegible]: Dece, a Poa (not prat?), Pogr, Asfo, Acmi, a Senecio, Trff, Pa[illegible] · similar to Dece ct of C. Idaho (d-c)

Litter/duff type, %coverage, depth: GRAMINOID (LOOSE), INCORPORATED IN ONE SEASON;

Bare ground: 40-50%

DOWN WOODY MATERIAL

Diam.	>30cm			8-30cm			3-8cm		
Length	>5m	2-5m	<2m	>5m	2-5m	<2m	>5m	2-5m	<2m
Sound									
Rotten									
Total									

Soil : 55-? : 4
[illegible] : 55-? : 5

SPECIES LIST

Site # 8

Observer J.S. Tuhy

Date 9-27-81

SHRUBS	cover	ht (dm)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

TREES	o/r	cover	ht
1			
2			
3			
4			
5			
6			
7			

TREES	1/d	ht (m)	limb	c.d.	top	fk	shape
1							
2							
3							
4							
5							
6							
7							

FORBS	cover	ht (dm)
1 Gafrifi		
2 prostrate lobed-lf Crucifer		
3 Veam ?		
4 Acfo ☆		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

GRAMINOIDS	cover	ht (dm)
1 Caro (have some infl's)	√	
2 Dece ☆		
3 other veg grass - Poa [illegible] Prat ??		
4 Cxaq ? - all Carex chewed		
5		
6		
7		
8		
9		
10		
11		
12		
13		

Ab - 5=dom, 4, 3, 2, 1, ½ = rare (or x)
crown class - D = dom, CD, I, S, Rep. = seedlings

☆ - on hummocks, more representative of surrounding Dece comm.

APPENDIX B

SOIL INTERPRETATION CLASSES

Profile Permeability Class (Erickson, 1973)

1. Very slow (vs) - less than 0.15 cm per hour.
2. Slow (s) - greater than 0.15 but less than 0.51 cm/hour.
3. Moderately slow (ms) - greater than 0.51 but less than 1.5 cm/hour.
4. Moderate (m) - greater than 1.5 but less than 5.1 cm/hour.
5. Moderately rapid (mr) - greater than 5.1 but less than 15.8 cm/hour.
6. Rapid (r) - greater than 15.2 but less than 50.8 cm/hour.
7. Very rapid (vr) - greater than 50.8 cm/hour.

Hydrologic Soil Group (USDA-SCS, 1972)

1. (Low runoff potential). Well excessively well drained soils with rapid infilitration and permeability rates.
2. (Moderately low runoff potential). Moderately well to well drained soils with moderately slow to moderately rapid infiltration rates.
3. (Moderately high runoff potential). Somewhat poorly drained soils with slow infiltration and permeability rates.
4. (High runoff potential). Poorly and very poorly drained soils with very slow infiltration and permeability rates.

Inherent Erodibility (Erickson, 1973)

Quantified in terms of "K" value determined from textural triangle nomograph and modified for soil structure, OM content and rock fragment composition.

1. High "K" is greater than 0.40.
2. Moderate (m) - "K" greater than 0.20 but less than 0.40.
3. Low (1) - "K" less than 0.20.

Drainage Class (USDA-SCS, 197b)

1. Very poorly drained (vp). Ground water table remains at or near the surface most of the time.
2. Poorly drained (p). Soil remains wet much of the time with the gwl seasonably near the surface for prolonged intervals.
3. Somewhat poorly drained (sp). Soil is wet for significant periods, but not continually as a result of relatively impermeable layers of a high gwl.
4. Moderately well drained (mw). Profile is wet for small but significant periods of time, usually because of a slowly permeable layer or an intermittently high (100-150 cm) gwl.
5. Well drained (w). Water is removed from the soil readily but not rapidly. Soils are generally free of mottling within the normal rooting depth of plants.
6. Somewhat excessively drained (sx). Water is removed rapidly. Soils are sandy and porous.
7. Excessively drained (ex). Water is removed very rapidly. Soils are fragmental or coarse sands.

Available Water Holding Capacity (Erickson, 1973)

Mean value calculated for horizons above the normal gwl.

1. Low (l) - less than 10% by volume.
2. Moderate (m) - greater than 10% but less than 20% by volume.
3. High (h) - greater than 20% by volume.

APPENDIX C

TAXA AND SOME HYDROLOGIC PARAMETERS OF PLOTS

Table 6. (Continued)

Plot	Subgroup Taxa	Fam (1)	Abbreviated Pedon Description Horizon(thickness)texture-coarse frag. (2)	gwl (cm) (3)	cfr (cm) (4)	AWC (%) (5)	Dr cl (6)	Perm cl (7)	IE cl (8)	Er cl (9)	HSG (10)
SAPH/MESIC											
*31	Typic Cryofluvent	cl	O(12)S,A(18)sl,C(30)sl,C(40)sl-30	110	60	15	mw	mr	l	n	B
*34	Aquic Cryoboroll	cl	O(21)H,A(23)sil,IIC(12)sic,IIC(7)sicl-35.	56	44	22	sp	s	l	n	C
SAGE/MESIC											
28	Aquic Cryofluvent	lsk	A(12)sl,C(35)sl,C(13)sl-30	47	12	11	sp	mr	m	n	C
DECE											
22b	Cumulic Cryoboroll	fl	A(35)l,IIA(15)l,IIC(20)cl	70	50	17	sp	s	m	n	C
29	Aquic Cryochrept	cl	A(7)l,AC(10)sil,B2(19)sl,C(39)sl	70	36	12	sp	m	m	n	C
CPa	Aquic Cryoboroll	fl	A(10)l,A(22)cl,AC(15)cl,C(13)scl	75	60	18	sp	s	m	n	C
SAPH/DECE											
23	Typic Cryofluvent	l	A(46)sil,C(54)sil	>100	85	18	sp	m	m	m	C

*Classification of these plots has not been verified;
(1)Textural Family: cl=coarse-loamy; f=fine; fl=fine-loamy; fr=fragmental; fsk=fine skeletal; l=loamy; s=sandy; ssk=sandy skeletal;
(2)Horizon(thickness)texture-coarse fragments;
(3)Depth to the ground water level;
(4)Depth to the top of the capillary fringe;
(5)Available water holding capacity (percent by volume);
(6)Drainage class: vp=very poor; p=poor; sp=somewhat poor; mw=moderately well;
(7)Permeability class: s=slow; ms=moderately slow; m=moderate; mr=moderately rapid;
(8)Inherant erodibility: h=high; m=moderate; l=low;
(9)Erosion class (actual): h=high; m=moderate; l=low;
(10)Hydrologic soil group (runoff class): A=low runoff potential; B=moderate; C=high; D=very high;

Table 6. (continued)

Plot	Subgroup Taxa	Fam (1)	Abbreviated Pedon Description Horizon(thickness)texture-coarse frag. (2)	gwl (cm) (3)	cfr (cm) (4)	AWC (%) (5)	Dr cl (6)	Perm cl (7)	IE cl (8)	Er cl (9)	HSG (10)
SAGE/CARO											
2	Typic Cryaquent	l	O(7)H,A(13)l,C(20)ls,C(20)scl	10	0	19	vp	m	l	n	D
9a	Typic Cryaquoll	l	O(18)S,A(42)l,C(10)sl,C(30)scl	10	0	26	vp	m	l	n	D
11	Typic Cryaquoll	fl	A(11)l,A(14)sil,AC(13)l,IIA(17)cl,IIAC.	55	0	18	p	s	m	n	D
17	Aquic Cryoboroll	l	A(20)l,C(18)sil,C(22)sl-30,C(20)scl	60	8	12	sp	m	m	m	C
SAPH/CACA											
21	Aquic Cryofluvent	fr	C(7)ls,C(21)sl,C(22)ls-60	50	40	8	sp	mr	m	m	C
25	Typic Cryaquoll	lsk	O(7)H,A(31)l,C(12)sil-35	40	0	19	p	m	m	n	D
32	Typic Cryofluvent	lsk	A(12)l,C(26)l,C(32)l-50	70	50	14	sp	mr	m	m	C
33	Typic Cryofluvent	cl	A(9)l,AC(25)l,C(39)l-10,C(10)l-40	80	36	17	sp	m	m	n	C
*35	Aquic Cryofluvent	cl	O(12)S,A(6)l,C(21)l,C(36)l-20,c(?)l-50	39	0	17	p	m	l	n	C
37	Mollic Cryofluvent	lsk	O(8)H,A(16)l,A(36)l-50	50	35	15	sp	mr	l	n	C
38	Typic Cryaquent	flsk	O(7)H,C(11)l,C(10)l-45	20	7	21	p	m	l	n	D
39	Aquic Cryofluvent	lsk	O(7)H,C(15)sil,C(13)sil-35	60	35	16	sp	m	l	n	C
SAGE/CACA											
10	Aquic Cryochrept	lsk	A(10)l,B(16)l,IIA(14)sl,IIB(12)ls,IIC-.	90	85	12	sp	m	m	m	C
14	Aquic Cryofluvent	cl	O(7)F,A(8)sl,C(22)sl,IIO(24)S,IIC(19)sl.	70	0	21	p	m	m	n	C
15	Mollic Cryofluvent	cl	A(15)l,C(28)sl-45,C(17)sl	65	43	10	sp	mr	m	n	C
SAWO/MESIC											
7	Aquic Cryoboroll	s/f	A(12)l,A(25)sl,IIA(26)l,IIC(17)ls,IIIC.	80	63	13	sp	m	l	n	D
12	Aquic Cryoboroll	f	A(12)l,A(21)cl,IIC(27)c	100	65	18	sp	s	m	n	C
19	Aquic Cryoboroll	f	O(9)H),A(32)l,C(11)cl,C(18)c	52	0	19	sp	s	l	n	D

Table 6. Soil taxa, abbreviated descriptions, interpretations and some hydrologic parameters of plots.

Plot	Subgroup Taxa	Fam (1)	Abbreviated Pedon Description Horizon(thickness)texture-coarse frag. (2)	gwl (cm) (3)	cfr (cm) (4)	AWC (%) (5)	Dr cl (6)	Perm cl (7)	IE cl (8)	Er cl (9)	HSG (10)
ELPA											
24c	Terric Borosaprist		O(100)s	0	0	30	vp		l	n	D
24b	Terric Borofibrist		O(40)H,O(45)F,O(15)scl	85	0	30	p		l	n	D
SAWO/SWPE											
*36	Aquic Cryorthent	fl	O(4)F,A(8)sil,AC(52)l,C(21)cl	70	12	18	sp	s	l	n	C
9b	Terric Borohemist		O(8)F,O(17)S,O(75)H	10	0	30	vp		l	n	D
18	Typic Cryaquent	fl	O(18)H,A(12)sicl,C(20)sicl	30	0	23	p	s	l	n	D
24	Typic Cryaquent	fl	O(23)H,C(8)l,IIA(12)sil,IIC(17)scl	10	0	29	vp	ms	l	n	D
*30	Typic Cryaquent	vf/fsk	O(23)H,A(17)c,C(14)c,C(6)sc-40	23	0	30	p	s	l	n	D
4	Aquic Cryorthent	fl	O(15)S,A(25)sil,AC(20)l,C(10)scl	40	0	22	p	s	l	n	D
CARO											
6	Aquic Cryoboroll	fl	A(20)l,IIC(50)sil,IIC(30)sil	20	0	18	p	m	m	n	C
22	Terric Borohemist	fr	O(95)H,C-65	50	0	30	p		l	n	D
26	Aquic Cryofluvent	fl	A(7)l,AC(26)sil,C(14)l,C(13)ls,C(10)cl.	60	47	16	sp	m	m	n	C
26b	Histic Cryaquoll	fl	O(20)H,A(40)l,C(25)cl,C(15)sl	60	40	21	sp	s	l	n	D
20	Aquic Cryorthent	f/ssk	O(9)S,A(25)c,C(16)ls-55,C(20)ls-40	80	70	21	sp	s	l	n	C
8	Aquic Cryofluvent	l/s	A(7)l,IIA(18)sil,IIIA(25)l,IIIC(30)s	50	25	17	sp	m	m	n	C
SAWO/CARO											
3	Aquic Cryofluvent	ssk	O(9)S,A(14)cl,C(7)ls,IIA(9)l,IIC(21)ls.	30	23	15	p	s	m	n	C
5	Typic Cryaquent	f	O(18)S,A(12)cl,C(30)cl,C(20)sicl	30	0	25	p	s	l	n	D
13	Typic Cryaquent	fl/f	O(15)H,A(9)sicl,C(18)scl,IIC(28)c	42	0	23	p	s	l	n	D
16	Typic Cryaquent	f/ssk	O(17)H,C(24)c,IIC(24)ls-30	41	0	23	p	s	l	n	D
36	Aquic Cryorthent	fl	O(4)F,A(8)sil,AC(52)l,C(21)cl	70	12	18	sp	s	l	n	D
HCb	Typic Cryaquent	fsk	O(14)H,A(16)cl,C(15)scl-30	14	0	24	p	s	l	n	D
SAPH/CARO											
1	Terric Borofibrist	f	O(9)H,O(41)F,C(10)cl,C(20)sc	10	0	30	vp	s	l	n	D
27	Histic Cryaquoll	fl	O(10)F,O(16)F,A(26)l,IIA&C(16)cl	52	0	24	p	s	l	n	D
*40	Aquic Cryofluvent	fl	A(7)l,AC(15)l,C(21)l,C(19)scl,IIA(13).	62	43	17	sp	m	m	n	C